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Microfungi parasitic on vascular plants in Waterton Lakes National Park, Alberta, and environs

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Microfungi parasitic on vascular plants in Waterton Lakes National Park, Alberta, and environs

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ABSTRACT

An annotated listing of the parasitic fungi on vascular plants found in Waterton Lakes National Park, Alberta is reported. Listed within their major taxonomic groups are 117 species within 44 genera and the rusts comprise well over half the species reported. Twelve new records of fungi and hosts for the park, province or country are noted and a host index aids the identification of the parasites.

RÉSUMÉ

Ce travail présente une liste annotée des parasites fongiques retrouvés aux lacs de Waterton Parc National, Alberta. On y rapporte 117 espèces dans 44 genres dont plus de la moitié sont des rouilles. On note douze nouvelles entités fongiques pour le parc, la Province, le Canada et un index des plantes-hôtes permet l'identification des pathogènes.

INTRODUCTION

The Biosystematics Research Institute of Agriculture Canada has conducted investigations of plants, fungi and insects in our National Parks. (Thomson and LeClair 1975, Parmelee 1982). The purpose is to inventory these organisms and provide reference specimens for the National Collections. This paper reports on the microfungi parasitic on vascular plants in Waterton Lakes National Park.

In 1980, the author collected obligate parasitic fungi at Waterton Lakes from mid August to early September and the flowering plant collection maintained at the Park was scrutinized. Some 50 specimens of parasitics were found from remote areas and of seasonal occurrence which would not have been available when I was in the field. Early collections from the Park, extant in the National Mycological Herbarium (DAOM), supplemented the collections from 1980. In total over 250 specimens of parasitic fungi are cited which represent 117 species in 44 genera. They are deposited in DAOM and duplicates of the 1980 material will also be deposited in the mycological collection of the Northern Forest Research Centre (CFB), Canadian Forest Service, Environment Canada, Edmonton, Alberta.

THE PARK

Waterton Lakes National Park occupies 203 square kilometres in the southwest corner of Alberta astride the meridian of longitude 114°W (Fig. 1). The Park is bounded on the south by the State of Montana at the 49° parallel of latitude and extends northward 22 km to an irregular boundary. The eastern boundary is also irregular and includes an area, predominantly grassland, which rises abruptly to the mountainous terrain of the Rockies. The western boundary follows the continental divide. The peaks of the mountains within the Park range in altitude from 2000-3000 metres and their creeks and streams drain into the Waterton lakes. Upper Waterton Lake is the largest and the southern third of its 11 km length lies in adjacent Glacier National Park in Montana. This larger neighbouring park in the United States of America has a similar topography and environment and the combined parks are known as the Waterton/Glacier International Peace Park.

Average daily minimum and maximum temperatures from May to September in Waterton Park range from 2.5°C-17°C in May to 7°C-22.5°C in August then drop back to the May averages in September. During the same period, the average monthly rainfall is between 5-10 cm totalling about 30 cm. The growing season between mid April and mid October may be said to be cool and dry.

The northeast section of the Park (see map) is open rolling grassland with spruce and poplar-lined rivers, and from the western edge of this prairie the mountains rise abruptly to support montane forests of needle-leaf trees with some broadleaf trees on the lower slopes and valleys. Lodgepole pine, Douglas fir and white spruce, give way with increasing altitude to subalpine associations of lodgepole pine, alpine fir, alpine larch and whitebark pine. Alpine meadows in the park were not forayed other than by scrutinizing the Park's phanerogamic collection. Mountain peaks are usually barren reflecting their extreme exposure and generally dry climate.

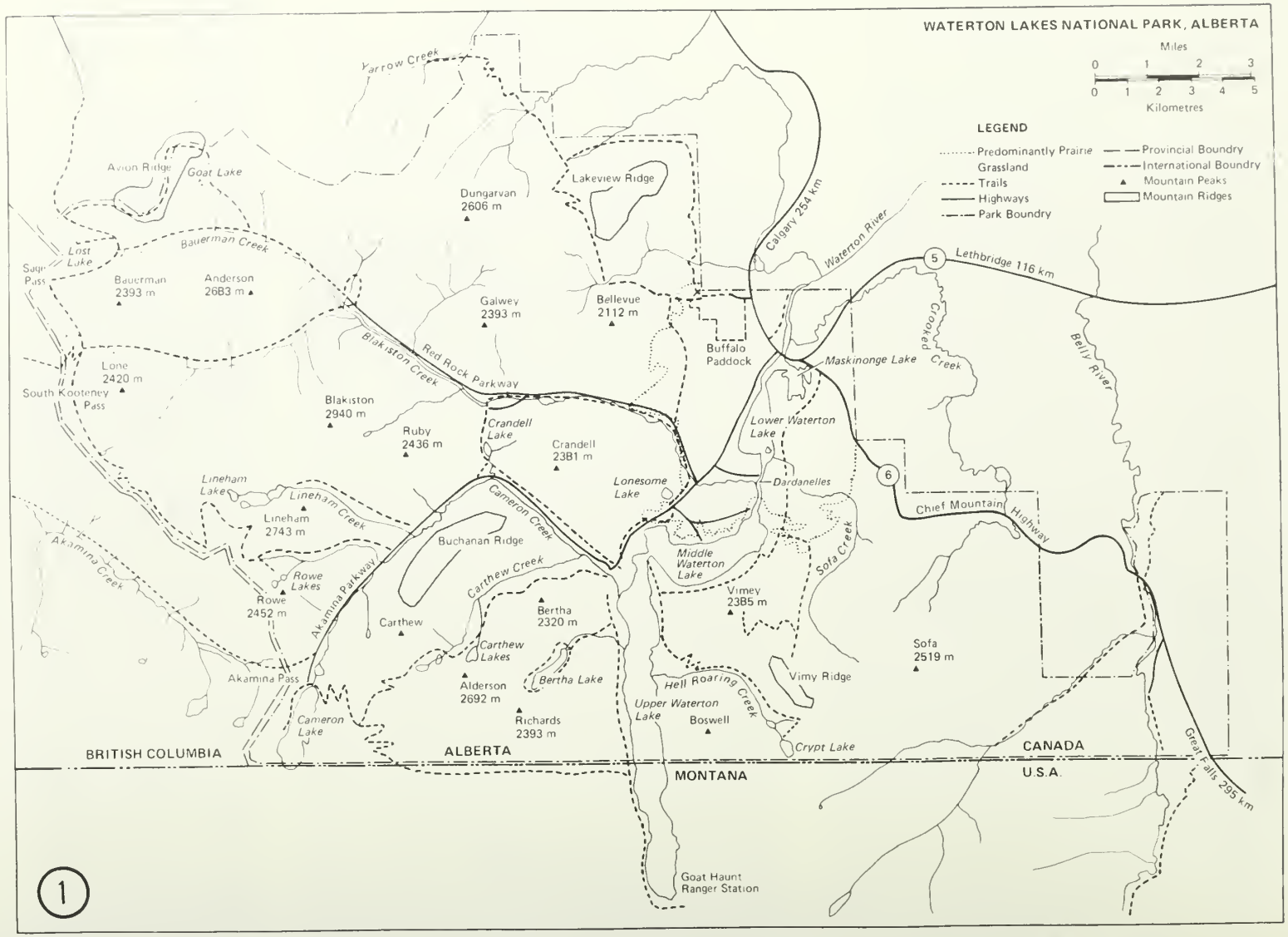
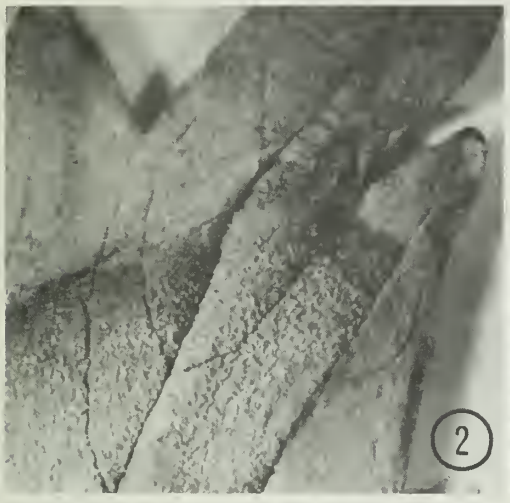


Fig. 1. Outline map of Waterton Lakes National Park, Alberta.

THE FUNGI

Fruiting bodies of fungi may have a diploid or a haploid nuclear condition. Fungi known only in the latter may possess one or more conidial states (anamorphs) and are classified as Hyphomycetes with conidia arising from a mycelium without an enclosing or protective vegetative body (Fig. 2); or, they are classified as Coelomycetes which have Conidia supported or enclosed within protective tissue (Fig. 3). All other fungi have a known



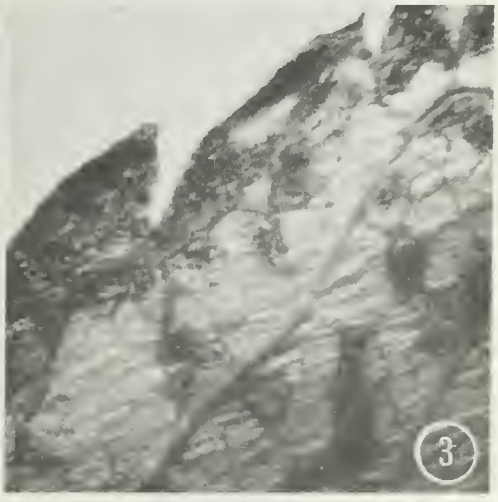


Fig. 2. White, aerial conidia and conidiophores of *Ramularia gei*, DAOM 185959; X9.6.

Fig. 3. Black, immersed pycnidia of *Phyllosticta angelicae*, DAOM 185960; X9.6.

teleomorph. In the Peronosporales (downey mildews) the teleomorph forms within the parasitized plant tissue and haploid anamorphs erupt as aerial conidia on the surface of the host. The Ascomycetes develop teleomorphs with sac-like asci which form ascospores internally but the complete life cycle might include an anamorph Coelomycete or Hyphomycete. In Taphrinales (blister fungi) the asci are borne naked on infected tissue whereas in Erysiphaceae (powdery mildews), the asci develop in completely closed and appendaged surface cleistothecia (Fig. 4). The comparable structure of a Pyrenomycete, the perithecium, has an opening (beak, channel or neck) through which the ascospores are released and in the Discomycetes this aperture may be a slit which opens variously to expose the asci. A fructification which opens widely to expose the entire ascus-bearing surface is known as an apothecium; it may be cup- or saucer-shaped and with or without a stalk. In the remaining major

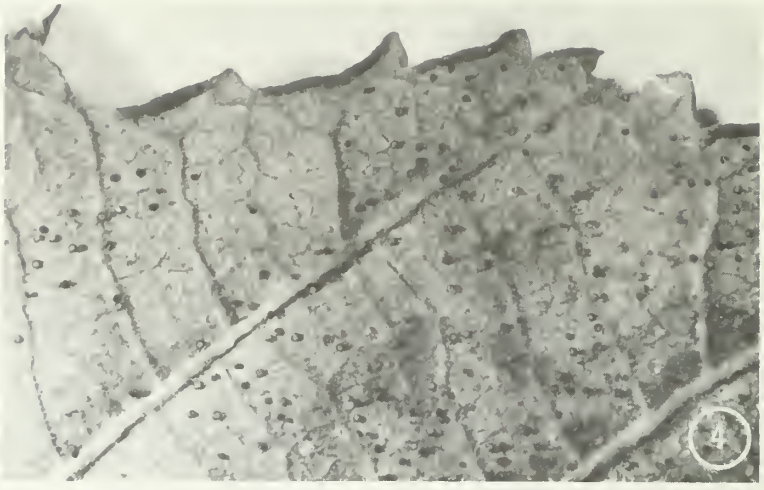


Fig. 4. Black, surface ascocarps of *Phyllactinia guttata*, DAOM 186054; X6.

group, the Basidiomycetes, the teleomorph forms structures bearing specialized hyphae, the basidia, and these in turn form external basidiospores.

The Uredinales (rusts), an order of obligate plant parasites in the Heterobasidiomycetes, represent over half the species reported in the present treatment. They may complete their full nuclear cycle on one host (autoecious) or on two unrelated hosts (heteroecious) and in so doing progress through various spore states one of which will be the teleomorph. A macrocyclic rust possesses pycnia (0), aecia (I), uredinia (II), telia (III) and basidia (IV). Some states may be omitted such that a complete nuclear cycle may occur having all states or only some *e.g.* 0,I,II,III; 0,I,III; $0,II^{1}$, II^{2}, III; $0,I^{III}$; 0,III and III. When a rust shortens its life cycle by omitting some states, the resulting short-cycled rust is recognized at the species level and is said to be correlated to its long-cycled projenitor *e.g.* the microcyclic *Puccinia recedens* is correlated to the long-cycled *P. angustata*. Spores from these different states are characteristically wind disseminated but rain and insects aid the spread of pycniospores in their role to bring about dikaryotization. Many teliospores are firmly attached to the host and do not become wind blown but germinate to produce wind disseminated basidiospores. The rusts are readily recognized by their strictly parasitic habit often with resulting chlorosis or malformation of the hosts. Aecia are typically bright orange to brown, becoming powdery, and enclosed or partially enclosed by a white peridium; uredinia are like-coloured and powdery but usually without a peridium; telia may be powdery or long-covered, cushion-shaped or columnar (Figs. 5 & 6). In comparison the Ustilaginales (smuts) produce sooty masses of teliospores (chlamydospores of

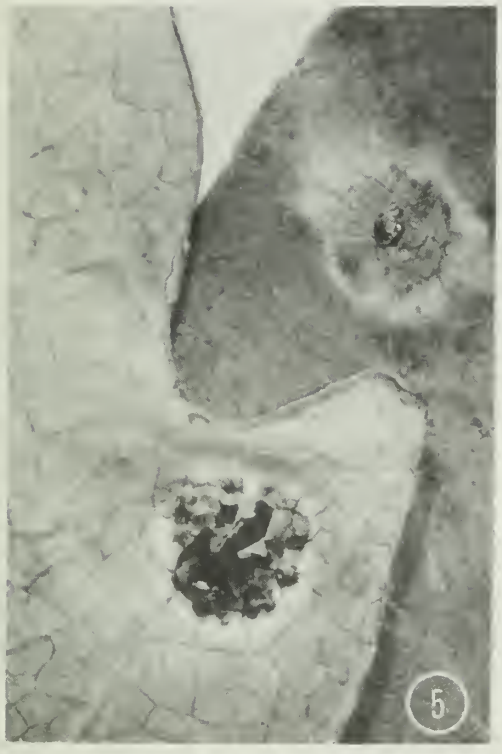


Fig. 5. Amphigenous, pulvinate telia (note chlorosis) of *Puccinia symphoricarpi*, DAOM 185994; X6.

Fig. 6. Caulicolous, gelatinized, columnar telia of *Gymnosporangium clavariiforme*, DAOM 133294 extra limital; X1.

some authors) on leaves, stems, or flower parts. They occasionally cause malformations but rarely chlorosis (Fig. 7). The Exobasidiaceae produce nonseptate basidia and cause bright yellow to red discolorations of foliage in the form of spots, blisters, bladders or brooms on which the naked basidia are borne.

Within the major groups outlined, fungi are recognized on characters of their anamorphs or their teleomorphs. In addition to the method of conidium production, ascocarp morphology, ascus and basidium characters, the following spore characters are essential in delimiting fungus species: spore size, shape, septation, and the number of cells, wall thickness, colour and

Fig. 7. *Anthracoidea atratae* on spikes of *Carex*, smutted (left) and healthy (right), DAOM 186026; X9.6.

ornamentation, number and location of germination pores. Secondary characters of species delimitation include the hosts attacked and the symptoms they exhibit.

THE HOSTS

Host names mainly follow the treatment by Moss (1959) and Kuijt's (1982) flora of the Park was helpful in determining the presence of certain hosts. When the identity of the diseased host is known, a host index is often a practical aid in identifying the causal fungus. A number of such indexes have been prepared for different geographic regions. In Canada, one by Conners (1967) is widely used and is currently being revised. Another by Shaw (1958) deals with the fungi of the Pacific Northwest (the States of Washington, Oregon, Idaho, Montana and the Province of British Columbia). There is no similar index for the Province of Alberta, but Lawrence and Hiratsuka (e.g. Forest fungi collected in Waterton Lakes National Park (1972)) have prepared host indexes of forest fungi for some of the National Parks in the province. A host index is included herein as an aid to the identification of the fungi reported.

THE FORMAT

The fungus genera and species are reported alphabetically within 13 major groups: Hyphomycetes (5); Coelomycetes (9); Phycomycetes: Peronosporales (1); Ascomycetes: Taphrinales (1); Erysiphaceae (11); Pyrenomycetes (4); Discomycetes (7); Basidiomycetes: Uredinales (74); Ustilaginales (2); Exobasidiaceae (3). Records new for the province of Alberta or for Canada

(12) are noted where appropriate and are indicated by an asterisk (*). A few fungi, hosts or specimens from outside the limits of the Park are included, within square brackets [], as being indicative of probable occurrence in the Park (*e.g.* collections taken at Goat Haunt, Montana at the southern end of Upper Waterton Lake or from British Columbia adjacent the Park boundary). To indicate the complete life cycle where states of a rust are not present in the material collected, symbols for them are included within round brackets ( ). Collection sites (cf. outline map) are given for all collections and accession numbers (DAOM) for selected ones but all sites listed are supported by specimens in DAOM. The acronymn alone, *i.e.* without a number, indicates that hosts, geographical regions etc. cited are based on specimens deposited in DAOM.

GENERAL REMARKS

As indicated earlier, the prairie grassland flora in the northeast region of the Park quickly changes to an open coniferous forest association westward with approach to the mountains. In comparison, Riding Mountain National Park in Manitoba has prairie elements associated with mixed forest. It is to be expected that some of the prairie parasitic microfungi in the two parks will be similar and some will differ. For instance *Puccinia balsamorhizae* present on *Balsamorhiza* in Waterton is absent with its host from Riding Mtn. *Hieracium, Taraxacum* and *Agoseris* (Asteraceae) of the prairies and lower mountain slopes occur in both parks and support respective autoecious rusts *Puccinia hieracii* (Rohl.) Mart. and *P. troximontis* Peck (on *Agoseris*). *Symphoricarpos* and *Viburnum* occur in both parks but the microcyclic *Puccinia symphoricarpi* Hark. is known only in Waterton while the unrelated *P. linkii* on *Viburnum* is known only in Riding Mountain. In these instances, absence of the parasites is probably only a reflection of a lack of collecting. This is also the explanation for the absence from Waterton of the leaf-spotting fungus *Glomopsis corni* (Peck) Henderson common on *Cornus canadensis* L. throughout Canada [Kouchibouguac, N.B., St. Lawrence Islands, Ont., Riding Mtn., Man., and Banff (Kananaskis), Alta. (DAOM)]. It is also to be expected that forest elements, both plant and fungus, will differ but there will be some similarities. *Amelanchier* and *Crataegus*, aecial hosts for *Gymnosporangium* rusts, are found in both parks but *Juniperus* spp., alternate hosts for the rusts were absent from Riding Mtn. but present in Waterton. *Gymnosporangium* (5 species) occurred only in Waterton. Five needle pines and currants (*Ribes* spp.) are present in Waterton as is white pine blister rust, *Cronartium ribicola* J.C. Fischer but at Riding Mtn. where currants are present and the five needle pines absent, *C. ribicola* is absent. In contrast *Coleosporium asterum* (Diet.) Syd., a needle rust, is present in both parks along with the alternate hosts the two-needle pines (*Pinus contorta* Dougl. and *P. banksiana* Lamb.) and the composites (*Aster* spp. and *Solidago* spp.).

THE PARASITIC MICROFUNGI

HYPHOMYCETES

Ramularia gei (Eliass.) Lindr. on *Geum macrophyllum* Willd., Twin Lakes Trail alt. 1770m (DAOM 185959) (Fig. 2). Cylindrical conidia arise as white aerial tufts from conspicuous leaf spots on the upper surface of leaves.

R. lonicerae Vogl. on *Lonicera utahensis* S. Wats., 4 km N Cameron Lake (DAOM 185950). The fungus appears on irregularly shaped leaf spots on the lower surface of leaves.

R. nivosa (Ell. & Ev.) W.B. Cooke & Shaw on *Penstemon albertinus* Greene, Lost Horse Canyon (DAOM 185952); Rowe Lakes Trail, alt. 2000 m (overmature). Leaf spots are large and bear the fungus on both sides of the leaf as small tightly grouped pale yellow clumps. The fungus is known (DAOM) on *P. nitidus* Dougl. ex Benth. ssp. *polyphyllus* Pennell from Missoula Co., Montana, and Moss (1959) reports this host for southern Alberta.

R. philadelphi Sacc. on *Philadelphus lewisii* Pursh, Crandell Mountain at 1500m, (DAOM 185951). This fungus is known from only one other collection in Canada on *P. gordonianus* Lindl. (DAOM 6765) from Spuzzum in the Fraser Valley, British Columbia. *P. lewisii* is a new host.

R. senecionis (Berk. & Br.) Sacc. on *Senecio triangularis* Hook., Pass Creek (DAOM 185953). White cottony tufts of conidia appear on the lower surface of leaves arising from conspicuous brown leaf spots. *Senecio hydrophylloides* Rydb. and *S. integerrimus* Nutt. bear this leaf spot in Wyoming (DAOM) and both species are reported in southern Alberta by Moss (1959) and in the Park by Kuijt (1982).

COELOMYCETES

Cylindrosporium heraclei Ell. & Ev. on *Heracleum lanatum* Michx., Maskinonge Lake (see *Phyllachora* DAOM 186083); near Cameron Lake (see *Phyllachora* DAOM 186082). [The fungus is known also (DAOM 89826) from Sperry Trail, Glacier National Park, Montana]. The conidia are 48-72x3.2-4.0µm and match well the dimensions given by Bisby *et al* (1938) for specimens from Manitoba and Saskatchewan (40-70x3-4µm). Conidia are borne in acervuli with no surrounding vegetative tissue. In section the acervuli lay adjacent to immature ascocarps of *Phyllachora* and dried conidia were evident overtop and around the immature teleomorphs. The observations strongly suggest genetic association between the *Cylindrosporium* and *Phyllachora*.

Kabatia lonicerae (Hark.) Höhn. var. involucrata Conners, on *Lonicera involucrata* (Richs.) Banks ex Spreng., Oil Basin (DAOM 185954). The fungus has not been reported previously from Alberta; it was recorded by Conners (1967) from British Columbia. Conidia of this fungus have a septum toward the base and Conners (1959) used this character to distinguish *K. lonicerae* from *Leptothyrium periclymeni* (Desm.) Sacc. which also attacks *Lonicera* but whose conidia have no septa.

Leptothyrium periclymeni (Desm.) Sacc. on *Lonicera utahensis* S. Wats., Rowe Lakes Trail (DAOM 185955). Red-brown, circular spots with a chlorotic border become tawny as the spots dry out; small dark spore-bearing acervuli form on the upper surface. This leaf-spotting fungus is known also in British Columbia (Conners 1967).

Phleospora anemones Ell. & Kell. on *Anemone multifida* Poir., Pass Creek picnic site (DAOM 185956). The black, immersed pycnidia appear abundantly on the lower surface of leaves, not on leaf spots as such, but over large areas which lose colour and become brown. Other *Anemone* spp. bear

this parasite (DAOM) including *A. riparia* Fern. on which the fungus is known as far east as Gaspé, Quebec.

*Phyllosticta angelicae Sacc. on *Angelica arguta* Nutt., Pass Creek picnic site (DAOM 185958) and 10 km S Belly River campground (DAOM 185960) (Fig. 3). A microconidial state forms hypophyllously on large spreading necrotic areas. This is a first report for Canada. When scrutinizing plant specimens in DAOM, the fungus was found on *A. genuflexa* Nutt. from Blue Ridge a hamlet NW of Edmonton.

*P. eriogoni B. Cooke on *Eriogonum umbellatum* Torr., Buffalo Paddock (DAOM 185961). A first report of this leaf spot for Canada.

P. minutissima Ell. & Ev. on *Acer glabrum* Torr., on Trails: Cameron Falls, Bears Hump (DAOM 185965), Blakiston Falls and Rowe Lakes (DAOM 185962). Irregular red-brown spots bear numerous, black pycnidia on the undersurface of the leaf. The fungus is known also in southern British Columbia, Glacier National Park, Montana and southward to Arizona (DAOM). It occurs also on *Acer rubrum* L., *A. saccharum* Marsh. and *A. spicatum* Lam. in eastern Canada.

Placosphaeria punctiformis (Fckl.) Sacc. on *Galium boreale* L. This is the anamorph of *Leptotrochila verrucosa* (Wallr.) Schueppe.

*Septoria osmorhizae Peck on *Osmorhiza purpurea* (Coult. & Rose) Suksd. Lone Lake, alt. 2040 m (DAOM 185966). The fungus is known on *O. longistylis* (Torr.) DC. in Ontario (DAOM) but this is the first report of this leaf spot on *O. purpurea* from Canada.

PERONOSPORALES

*Peronospora parasitica (Pers.:Fr.) Fr. on *Lepidium latifolium* L., near Park gate. The fungus appears as a delicate, white, aerial growth on the underside of leaves which become chlorotic. This is a first report for Alberta.

TAPHRINALES

Taphrina nana Johans. on *Betula* sp., locality given only as Waterton Park (DAOM 117427). Field notes on the specimen packet report the occurrence of a large, witches' broom; leaves within the packet were blistered and necrotic over large areas. Similar symptoms were evident on *B. pumila* L. from Nordegg, SW of Edmonton. This leaf-curl fungus is known on *B. glandulosa* Michx. from British Columbia and from Quebec but it is not abundantly represented in DAOM.

ERYSIPHACEAE

Erysiphe cichoracearum DC. ex Mérat on *Aster ciliolatus* Lindl., Lost Horse Canyon (DAOM 186027); *A. laevis* L., Pass Creek; *Aster* spp. near Park Gate; Pass Creek; *Grindelia squarrosa* (Pursh) Dunal, Waterton townsite; Buffalo Paddock; *Lappula redowskii* (Hornem.) Greene, Buffalo Paddock; *Lycopus americanus* Muhl., Buffalo Paddock (DAOM 186033); *Mentha arvensis* L. var. *villosa* (Benth.) S.R. Stewart, near Park gate; *Monarda fistulosa* L., Dardanelles; *Polemonium pulcherrima* Hook., rolling prairie above Blakiston Creek (DAOM 186035); *Solidago lepida* DC., Pass Creek. This is a

common mildew of Asteraceae but it attacks also other plant families. Numerous irregular appendages on cleistothecia are similar to those on cleistothecia of the genus *Sphaerotheca* however the ascocarps in *Erysiphe* contain many asci while there is but one in *Sphaerotheca*.

E. graminis DC. ex Mérat on *Agropyron repens* (L.) Beauv., Cameron Falls (DAOM 186037). As is usual in this very common mildew of grasses and cereals, ascospores had not formed when the collection was made in late August, and they were not found in any Canadian specimens seen by Parmelee (1977).

E. polygoni DC. ex St. Amans on *Polygonum aviculare* L., Lakeview Ridge, alt. 1380 m (DAOM 186040); *Ranunculus acris* L., open prairie beside Dardanelles; *Thalictrum occidentale* A. Gray, Dardanelles (DAOM 186038). Plants in many families are susceptible to this fungus especially those in Polygonaceae and Ranunculaceae. The above hosts are new records for Alberta.

Microsphaera diffusa Cke. & Peck on *Oxytropis campestris* (L.) DC., near Buffalo Paddock (DAOM 186041); *Symphoricarpos albus* (L.) Blake, Bears Hump Trail, alt. 1500 m; Buffalo Paddock; Bertha Falls Trail (DAOM 186042); *S. occidentalis* Hook., Dardanelles (DAOM 186045). The dichotomous branching of the appendage tips distinguishes this genus from *Erysiphe*; other characters of the appendages are useful in separating the species.

M. penicillata (Wallr.:Fr.) Lév. on *Betula papyrifera* Marsh., Pass Creek (DAOM 186048a); *Lathyrus ochroleucus* Hook., Bertha Falls Trail; Dardanelles (DAOM 186047). Paper birch also bears *Phyllactinia*. In addition to plants in Corylaceae and Fabaceae other hosts in Canada occur in the families Caprifoliaceae, Cornaceae, Fagaceae, Oleaceae and some others.

Phyllactinia guttata (Wallr.:Fr.) Lév. on *Alnus crispa* (Ait.) Pursh, Blakiston Falls; Rowe Lakes Trail (DAOM 186054) (Fig. 4); Cameron Falls (DAOM 186052); Crandell Lake Trail; *Betula occidentalis* Hook., Maskinonge Lake; Dardanelles (DAOM 186049); Pass Creek. This is a widely distributed mildew in Canada. Other known hosts include: *Amelanchier, Cornus, Corylus, Fagus, Quercus, Fraxinus* and many climbing and shrubby plants such as *Xanthoxylum* or *Celastrus*. The genus *Phyllactinia* is characterized by large cleistothecia with stiff, acicular and bulbous based appendages.

Podosphaera clandestina (Wallr.:Fr.) Lév. on *Crategus chrysocarpa* Ashe, Pass Creek (DAOM 186056); *Prunus virginiana* L., Buffalo Paddock. Conners (1967) records this mildew on cherry from Manning in the Peace River region and on hawthorne from Edmonton. Susceptible plants are mainly in Rosaceae. The dichotomously forked appendages and cleistothecia with just a single ascus are characteristic of this genus.

P. myrtillina (Schub.) Kunze on *Vaccinium membranaceum* Dougl., above Cameron Lake (DAOM 105587, with *Pucciniastrum vaccinii*). Early reports of this mildew on blueberry refered the fungus to *P. clandestina* but the latter has consistenly shorter appendages.

Sphaerotheca fuliginea (Schlecht.:Fr.) Poll. on *Arabis drummondii* A. Gray, Blakiston Creek (DAOM 186057a); *Arnica cordifolia* Hook., Cameron Falls; *Castilleja miniata* Dougl., Rowe Lakes Trail; *Draba* sp., Lost Horse Canyon; *Gaillardia aristata* Pursh, prairie above Blakiston Creek (DAOM 186061); *Heuchera cylindrica* Dougl., Lost Horse Canyon and Red Rock Canyon; *Taraxacum officinale* Weber, Bauerman Creek. In Canada hosts are mainly in

the Asteraceae and Brassicaceae but may also be in Fabaceae, Lamiaceae, Saxifragaceae and Scrophulariaceae.

S. macularis (Wallr.:Fr.) Magn. on *Geranium richardsonii* Fisch. & Trautv., near Park Gate (DAOM 186065); *G. viscosissimum* Fisch. & Mey., open rolling prairie of Buffalo Paddock. This mildew attacks other hosts, especially in the family Rosaceae, in Canada. These are listed in Fungi Canadenses No. 63.

Uncinula adunca (Wallr.:Fr) Lév. on *Salix* spp., shores of Lower Waterton Lake (DAOM 186067); *Populus* sp., Coppermine Creek (DAOM 180017). The cleistothecial appendages are hooked at their tips and differences in the curling and twisting of the tips are important in species differentiation. Lower branches of both hosts, and especially basal suckers, often become 'white' with the surface mycelium of this fungus. Distribution of this mildew ranges from coast to coast in Canada.

PYRENOMYCETES

Apiosporina morbosa (Schw.) v. Arx on *Prunus pensylvanica* L.f. east of Waterton townsite (DAOM 186070); *P. virginiana* L.f., Red Rock Canyon Parkway (DAOM 180018). The conspicuous black knots on the branches if severe enough reduces tree vigor. Illustration, description and distribution in Canada is given in Fungi Canadenses No. 84. *A. collinsii* (Schw.) v. Höhn. on *Amelanchier* spp. was not collected in the Park but is widespread in Alberta (Kananaskis to Peace River) and Canada; see Fungi Canadenses No. 76.

Herpotrichia juniperi (Duby) Petrak (= *H. nigra* Hartig), on *Abies lasiocarpa* (Hook.) Nutt., Rowe Lakes Trail; Summit Lake (DAOM 176590); *Juniperus communis* L., Akamina Parkway (DAOM 180025); *Picea engelmanii* (Parry) Engelm., near Summit Lake (DAOM 117876); *Pinus contorta* Dougl. var. *latifolia* Engelm., Rowe Lakes Trail (DAOM 186071). When snow covers lower branches for prolonged periods, brown snow mold becomes common. It is especially evident in mountain habitats.

Mycosphaerella chimaphilae (Ell. & Ev.) Höhn on *Chimaphila umbellata* (L.) Bart. var. *occidentalis* (Rydb.) Blake, Rowe Lakes Trail (DAOM 186072). The fungus fruits amphigenously on necrotic centres of dark, conspicuous leaf spots. The fungus is widely distributed in Canada but is rarely collected. This is the first record on *Chimaphila* in Alberta.

Phyllachora heraclei (Fr.) Fckl. on *Heracleum lanatum* Michx., Akamina Parkway near Cameron Lake (DAOM 186082); Maskinonge Lake (DAOM 186083). Black immature ascocarps 'pepper' the undersurface, and opposite, the leaf becomes diffusely chlorotic. There is strong evidence by association that the anamorph is *Cylindrosporium heraclei*.

DISCOMYCETES

*Cryptomycina pteridis (Reb.:Fr.) Höhn. as the anamorph *Cryptomycella pteridis* (Kalchbr.) Höhn. on *Pteridium aquilinum* (L.) Kuhn var. *pubescens* Underw., Cameron Falls (DAOM 186073). The black conidiomata are hypophyllous on many pinnules of a frond. The anamorph is present on current years growth and the teleomorph (*Cryptomycina*) develops and matures in the conidiomata on

overwintered tissue. There are abundant specimens (DAOM) from Eastern Canada and British Columbia, one only specimen from Manitoba and this is the first report of occurrence in Alberta.

Isthmiella abietis (Dearn.) Darker on *Abies lasiocarpa* (Hook.) Nutt., Cameron Lake (DAOM 186074). The black, linear hysterothecia are conspicuous on the underside of the needles. *I. faullii* (Darker) Darker on *Abies balsamea* is known only in eastern Canada and is recognized by its ascospore shape i.e. thicker constriction.

Leptotrochila verrucosa (Wallr.) Schuepp as the anamorph *Placosphaeria punctiformis* (Fckl.) Sacc. on *Galium trifidum* L., trailhead to Crandell Lake at Church Campground (DAOM 186075). Most of the material in DAOM is of the *Placosphaeria*. Elsehwere in Alberta, Kananaskis and Miette, this leaf spot is known on *Galium boreale* L.

Lirula abietis-concoloris (Mayer ex Dearn.) Darker (= *Hypodermella abietis-concoloris* Mayer ex Dearn.) on *Abies lasiocarpa* (Hook.) Nutt., Blakiston Falls Trail (DAOM 186076). Lawrence and Hiratsuka (1972) report *L. nervata* (Darker) Darker on *Abies lasiocarpa* from the Park but all specimens of it in DAOM are from eastern Canada. The hysterothecia of *L. abietis-concoloris* are intraepidermal in contrast to subepidermal ones in *L. nervata* (Darker 1932, 1967).

Lophodermium juniperi (Grev.) Darker on *Juniperus communis* L. var. *depressa* Pursh, Little Prairie Picnic site north of Cameron Lake (DAOM 186077). This needle cast fungus is known also from Banff (DAOM). It is known also in British Columbia on the above host and on *J. scopulorum* Sarg. (DAOM); and it occurs widely in eastern Canada on the common juniper and on *J. horizontalis* Moench. The specimen from Little Prairie also bears abundant apothecia of *Chloroscypha sabinae* (Fckl.) Dennis (= *Kriegeria juniperina* Seaver) det. R.A. Shoemaker, on necrotic needles; it is doubtfully parasitic.

*Rhytisma arbuti Phill. as the anamorph *Melasmia menziesiae* Dearn. & Barth. on *Menziesia glabella* A. Gray, Blakiston Falls Trail; Rowe Lakes Trail; Bertha Falls Trail (DAOM 117863). The large circular black ascocarps are epiphyllous and conspicuous even though immature. The fungus is known also in British Columbia (DAOM).

*Rhytisma salicinum (Pers.) Fr. on *Salix* sp., near Cameron Lake (DAOM 186081). Willow tar spot is known also from Kananaskis and Banff but otherwise it is poorly represented in DAOM from Alberta. Tar spot is widely distributed in Canada being found well into the high arctic, *e.g.* 81°50'N on Ellesmere I. and 80°N on Axel Heiberg Island. The asci and ascospores mature on fallen leaves of the previous season but specimens of the conspicuously spotted leaves of the current season are usually collected, hence most herbarium material contains no asci.

UREDINALES

Chrysomyxa ledi deBary var. glandulosi Savile 0,I on *Picea engelmanii* Parry, Cameron Lake (DAOM 97405); II,III hypophyllous on *Ledum*

glandulosum Nutt., Akamina Parkway; Cameron Lake (DAOM 97406); Akamina Pass (DAOM 128408). *Chrysomyxa ledi* var. *groenlandici* Savile on *Ledum groenlandicum* Oeder is widely distributed in Canada and indeed in Alberta but has not been found in the Park.

*C. pirolata Wint. [0,I systemic on cone scales of *Picea glauca* (Moench) Voss, reported from foothills near Red Deer River (For. Insect & Disease Survey 1971)]; II,III systemic on above ground parts of *Pyrola virens* Schweigg. only as "Waterton Lakes" (DAOM 23903). The microcyclic *Chrysomyxa weirii* Jacks. with telia on 2-year-old needles of white spruce is known from the Rocky Mtn. foothills (ibid. 1970) but not within the Park. It is not known to cause as serious damage as does *C. pirolata*.

*Coleosporium asterum (Diet.) Syd. 0,I on needles of *Pinus contorta* var. *latifolia* Engelm., 2km N Cameron Lake (DAOM 186094) and recorded by Lawrence and Hiratsuka (1972); II,III on *Aster conspicuous* Lindl., Rowe Creek; Blakiston Falls; Cameron Lake; Row Lakes Trail (DAOM 186098); *A. ciliolatus* Lindl., Cameron Lake; Bauerman Creek; *A. laevis* L., Red Rock Canyon Trail; Pass Creek (DAOM 186102); *A. modestus* Lindl., 10 km S Belly Creek Campground; *Solidago missouriensis* Nutt., Crandell Lake Trail (DAOM 186104); Buffalo Paddock; near Lonesome Lake; adjacent Dardanelles. This common and wide ranging rust in Canada was common on *Pinus banksiana* Lamb. and on other species of *Aster* and *Solidago* in Riding Mountain National Park, Manitoba in 1979 (Parmelee, 1982).

Cronartium ribicola J.C. Fischer 0,I on *Pinus flexilis* James are recorded for the Park by Lawrence and Hiratsuka (1972) and on *P. albicaulis* Engelm. for Alberta by Conners (1967); other susceptible five-needle pines are listed by Ziller (1974) who provides excellent illustrations of the rust symptoms and spore morphology. II,III on *Ribes oxyacanthoides* L., Mt. Rowe, alt. 1710 m (DAOM 186085); Red Rock Canyon; *R. triste* Pall. and *R. viscosissimum* Pursh are recorded as hosts in the Park (Lawrence and Hiratsuka, *op. cit.*).

Cumminsiella mirabillissima (Peck) Nannf. 0,I,II,III on *Mahonia repens* (Lindl.) G. Don, Lower Bertha Falls, alt. 1410 m; Belly River at international border, alt. 1350 m (DAOM 186086).

Endocronartium harknessii (J.P. Moore) Y. Hiratsuka $0,I^{III}$ on *Pinus contorta* Dougl., Crandell Lake Trail. This gall-forming rust repeats on the pine host. Spores are similar to aeciospores of *Cronartium* spp. but they function as teliospores by producing basidia and basidiospores upon germination to reinfect the pine.

Gymnosporangium clavariiforme (Pers.) DC. 0,I on leaves and fruit of *Amelanchier alnifolia* Nutt., Red Rock Canyon Parkway (DAOM 186116); Rowe Lakes Trail; III on *Juniperus communis* L. var. *depressa* Pursh are cylindrical from slightly fusiformed branches but were not collected in the Park in 1980 as the season (August-September) was too far advanced; telia usually mature in May (Fig. 6). *J. communis* is fairly common in open and protected dry places in the Park (Kuijt 1982).

G. clavipes (Cke. & Peck.) Cke. & Peck 0,I on leaves and fruit of *Amelanchier alnifolia* Nutt., Blakiston Creek; Buffalo Paddock; Rowe Lakes

Trail (DAOM 186120); Chief Mountain Customs, alt. 1560 m; [*Crataegus douglasii* Lindl., Goat Haunt, Glacier National Park, Montana]; III on *Juniperus communis* L. var. *depressa* Pursh are pulvinate (hemispherical) on very young branches and although not collected in the Park due to the advanced season, the presence of heavy aecial infections of the Saskatoon shrubs indicates their presence.

G. nelsonii Arth. 0,I hypophyllous on *Amelanchier alnifolia* Nutt. Blakiston Falls, alt. 1650 m; Blakiston Creek (DAOM 186090); 2 km N Cameron Lake and a specimen (DAOM 133579) from Pincher Creek associated with *J. horizontalis*; III are cylindrical-conical arising from globoid galls on *Juniperus horizontalis* Moench, Blakiston Creek (DAOM 186125) associated with 0,I at same site; *J. scopulorum* Sarg., Mt. Anderson; Blakiston Falls, Alt. 1200 m (DAOM 186091).

G. nidus-avis Thaxt. 0,I on *Amelanchier alnifolia* Nutt., Rowe Lakes Trail (DAOM 186129) and known also from near Pincher Creek (DAOM 132964); III on *Juniperus horizontalis* Moench as small pulvinate sori associated with birds-nest foliage, Red Rock Canyon Trail (DAOM 186093) and from Pincher Creek (DAOM 11/410). Telia occur on *J. scopulorum* Sarg. causing nests or brooms [DAOM 132962 Crowsnest Lake, Alta.] but are not known from the Park.

G. tremelloides Hartig. 0,I on *Sorbus scopulina* Greene, Rowe Lakes Trail; Blakiston Falls Trail (DAOM 186131); Cameron Lake; III on *Juniperus communis* L. var. *depressa* Pursh, Rowe Lakes Trail (DAOM 186133) and recorded also by Lawrence and Hiratsuka (1972). Telia appear on globoid galls (up to 20 mm diam.) as a flat surface layer covering part or most of the gall. [Telial specimens from east of Logan Pass and from St. Marys in Glacier National Park, Montana are on deposit in DAOM.]

Hyalopsora polypodii (Pers.) Magn. 0,I are unknown, they presumbaly occur on needles of Pinaceae, probably on *Abies*. II(III) on *Cystopteris fragilis* (L.) Bernh., appear on the underside of fronds as yellow, blister-like pustules which split open to become powdery. [Goat Haunt south end of Upper Waterton Lake, Montana (DAOM 186188)].

Melampsora epitea Thüm. 0,I on needles of coniferous trees but unknown in the Park; II,III on *Salix bebbiana* Sarg., Dardanelles (DAOM 186216); Rowe Lakes Trail; *S. discolor* Muhl., Maskinonge Lake; *S. drummondiana* Barratt, Crypt Lake (DAOM 186204); *S. planifolia* Pursh, Blakiston Falls Trail. The binomial *M. epitea* was proposed by Hylander, Jørstad and Nannfeldt (1953) for a number of *Melampsora* species parasitic on *Salix* and having unrelated 0,I hosts like *Abies*, *Ribes* and *Saxifraga*. The taxonomy of the willow rusts of Japan have been revised by Hiratsuka and Kaneko (1982) and similar work is needed for the North American taxa. Inoculation trials would be most helpful in such a task.

M. medusae Thüm. (= *M. albertensis* Arth.) 0,I on *Pseudotsuga menziesii* (Mirb.) Franco and *Pinus spp.* (Ziller 1974) based on inoculations but there are no records from the Park; II,III hypophyllous on *Populus tremuloides* Michx., Red Rock Canyon Trail (DAOM 186207) especially heavy on foliage near ground level.

M. occidentalis Jacks. 0,I on *Pseudotsuga*, *Larix*, *Pinus* and *Abies* based on inoculation tests by Ziller (1974) but not known from the Park; II,III on *Populus balsamifera* L., Lost Horse Canyon; Buffalo Paddock; Pass Creek; *P. trichocarpa* T.&G., Maskinonge Lake; Dardanelles (DAOM 186210).

M. paradoxa Diet. & Holw. 0,I on *Larix* spp. reported from Alberta by Ziller (1974) but specimens not seen by me; II,III *Salix exigua* Nutt. Middle Waterton Lake, east shore (DAOM 186219). The urediniospores fit the size range given by Arthur (1934), otherwise the specimen could be assigned to the *M. epitea* complex.

Melampsorella caryophyllacearum Schroet. 0,I on *Abies lasiocarpa* (Hook.) Nutt., Rowe Creek at Akamina Parkway causing perennial witches' brooms. II,III on *Cerastium arvense* L., not collected in 1980, but reported for the Park (Lawrence and Hiratsuka 1972) and there are specimens by E.H. Moss from the Park (DAOM 97217) and from Pincher Creek (DAOM 117356). Fir broom rust also alternates to *Stellaria* spp. with Canadian specimens widely distributed and ranging well north of treeline (Tuktoyaktuk, NWT. DAOM 115774 and Shingle Point, Yukon, DAOM 115773). Broom rust occurs in western Alberta, British Columbia and Yukon on *Abies lasiocarpa* and throughout the range of *Abies balsamea* L. in Canada.

Phragmidium andersoni Shear 0,I,II,III on *Potentilla fruticosa* L., Red Rock Canyon Trail; Crandell Lake Trail; Bears Hump Trail (DAOM 186191); Park Gate. This is a widely distributed rust in Canada (DAOM) with specimens from Newfoundland to British Columbia and Yukon.

P. ivesiae Syd. 0,I,II,III on *Potentilla gracilis* Dougl., Red Rock Canyon Trail (DAOM 186195), Crandell Lake Trail. Savile (1976) lists many cinqfoils as hosts for this rust. On *P. gracilis* it is found in the four western provinces and on *P. recta* L. it is found abundantly in Ontario.

P. montivagum Arth. 0,I,II,III on *Rosa acicularis* Lindl., 2 km N Cameron Lake (DAOM 186196); *R. woodsii* Lindl., Buffalo Paddock; Red Rock Canyon Trail (DAOM 186198); Bears Hump Trail. Canadian collections of this rust in DAOM are from the four western provinces only.

P. occidentale Arth. (0,I,II)III on *Rubus parviflorus* Nutt., Bears Hump Trail (DAOM 186200). Scattered clumps of black telia erupt from the lower surface of the leaves. The specimen was collected in late August when only telia were present (see F. Canadenses No. 80). *Phragmidium* rusts reported here all have large, darkly pigmented and coarsely verrucose teliospore walls and spores have 2- many horizontal septa. *Phragmidium ivesiae* has clylindrical pedicels the other species have hygroscopic pedicels in the basal half.

Puccinia aberrans Peck 0,III on *Smelowskia calycina* (Steph.) C.A. Mey. var. americana (Regel & Herd) Drury & Rollins, [Twin Lakes Peak, alt. 2250 m, B.C., 49°08'N 114°10'W] and N of coleman, Alberta. Collection sites of the 7 DAOM specimens are all from alpine altitudes in the Rocky Mts. of British Columbia and Alberta.

P. asteris Duby III on *Asteris conspicuous* Lindl., south-facing slopes Mt. Lineham; [Goat Haunt, Glacier National Park, Montana]; Blakiston Falls (DAOM 186136); *A. puniceus* L., trail to Upper Rowe Lakes alt. 2010 m. Based on specimens in DAOM, this microcyclic rust is known elsewhere in Alberta on: *A. ciliolatus* Lindl., *A. crassulus* Rydb., *A. ericoides* L., *A. foliaceus* Lindl., *A. laevis* L., *A. pansus* (Blake) Cronq.

P. atrofusca (Dudl. & Thomp.) Holw. 0,I on *Artemisia* spp., widely distributed in Alberta but not collected in the Park; II,III on *Carex geyerii* Boot, Trail to Summit Lake, alt. 1860 m (DAOM 124955). This rust is

distributed northward through Swan Hills into the Yukon and it attacks many species of *Carex* in Alberta and elsewhere in Canada.

P. austroberingiana (Savile) Savile ssp. austroberingiana III on *Mitella pentandra* Hook., Red Rock Canyon (DAOM 186139) and recorded by Savile (1973) from the Park. Teliospores germinate soon after formation (leptosporic) without an overwintering period. In such microform rusts there are minimal morphological characters usuable in species recognition.

P balsamorhizae Peck 0,II[1],II[2],III on *Balsamorhiza saggitata* (Pursh) Nutt., rolling prairie above Blakiston Creek (DAOM 186140). The dry prairie of the Park is not unlike that of southern British Columbia where the rust is moderately common and when this species was described in Fungi Canadenses No. 89 its presence in Waterton was forecast because *Balsamorhiza* itself was there (Moss 1959).

P. bistortae (Str.)DC. 0,I on Apiaceae (Umbelliferae): *Cicuta, Conioselinum, Ligusticum, Sium*, known only from northern Quebec and Newfoundland in Canada; II, III on *Polygonum viviparum* L., road to Chief Mountain, alt. 1500 m and from the Kananaskis and Edmonton areas. It ranges well into the Canadian Arctic where it exists without alternation. *Puccinia ligustici* Ell. & Ev. is the correlated microform rust on the hosts for the aecia and it is known only from cool moist areas of British Columbia in Canada.

[P. blyttiana Lagerh. III on *Ranunculus pygmaeus* Wahl., King Edward Peak, British Columbia 49°00'N 114°12'W (DAOM 60073), adjacent Waterton. Canadian distribution and morphological comparison with six other microcyclic rusts on Ranunculaceae are given in Fungi Canadenses Nos. 262-268].

P. calochorti Peck (0,1,II) III on *Calochortus apiculatus* Baker, Twin Lakes Trail, alt. 1770 m (DAOM 186142). This is the first collection for Alberta (DAOM) but the rust is known from St. Mary, Montana and from the Flathead valley in British Columbia adjacent to the Park. The rust is widely distributed in south-central B.C. on the above host and on *C. macrocarpus* Dougl.

P. caricina DC. *s.l.* 0,I on *Ribes* spp.; *Urtica* widely distributed in Alberta but not represented from the Park in DAOM; II, III on *Carex aquatilis* Wahl., Blakiston Creek (DAOM 186143) and DAOM 97235 only as Waterton. This rust has a world-wide distribution. It is likely that some of the varietal segregates treated by Arthur (1937) may be recognized at the specific level if inoculation studies link recognizable aecial characters with separable uredinial/telial characters.

P. caricis-shepherdiae J.J. Davis 0,I on *Shepherdia canadensis* (L.) Nutt., Blakiston Falls Trail; [south of Pincher Creek (DAOM 105547)]; aecia are hypophyllous in diffused groups; II,III *Carex aquatilis* Wahl., Blakiston Creek (DAOM 186145). Like *P. caricina*, this rust attacks many species of *Carex* but it is recognized by its broader urediniospores and teliospores both of which have thicker walls. *Shepherdia* is also an alternate host of *Puccinia coronata*.

P. clintonii Peck var. bracteosae Savile III on *Pedicularis bracteosa* Benth., Cameron Lake (DAOM 186146). This is the only variety, of the seven recognized by Savile (1967), to occur in Alberta. It is known also (DAOM) from Kananaskis and Lake Louise. In British Columbia, our specimens are from the Cathedral Lakes (49°N) to Fairy Lake (57°N).

P. cnici Mart. (0,I,II) III on *Cirsium flodmanii* (Rydb.) Arth. Pass Creek (DAOM 186148); *Cirsium vulgare* (Savi) Tenore, Buffalo Paddock (DAOM

186147). Keys to the species of *Puccinia* on *Cirsium* and other Cardueae are based on spore characters (Savile 1970).

P. coronata Cda. 0,I on *Shepherdia canadensis* (L.) Nutt., Crypt Landing, Upper Waterton Lake (DAOM 186150); aecia are hypophyllous in tight circular groups; II,III on *Bromus pumpellianus* Scribn., Crandell Lake Trail (DAOM 186149); *Calamagrostis inexpansa* A. Gray, Dardanelles; Blakiston Creek. The primary aecial host in Canada is *Rhamnus* which is not common in Alberta (Moss 1959). In 1979, crown rust was very heavy on buckthorn in Riding Mountain National Park (Parmelee 1982).

P. crandallii Pam. & Hume 0,I on *Symphoricarpos albus* (L.) Blake, Bears Hump Trail, alt. 1410 m (DAOM 186153) aecia were overmature when collected on 24 August. Elsewhere in southern Alberta, aecia have been found on *S. occidentalis* Hook. The II,III states were not found in 1980 but are known to occur on *Festuca* and *Poa* in Alberta. In southern Alberta they occur on *Festuca idahoensis* Elmer (DAOM).

P. dasantherae Savile I,III on *Penstemon ellipticus* Coult. & Fisher, only as "Waterton Park" (DAOM 97485); Carthew Peak, alt. 2100 m (DAOM 124969); [Sun Point, St. Mary Lake, Montana]; *P. fruticosa* (Pursh) Greene, near Summit Lake (DAOM 97487). Teliospores have germ pores depressed from the apex in the upper cell and from the septum in the lower cell. These characters, and others pertaining to the aecia, distinguishes this species from *P. palmeri* Diet. & Holw. also on *Penstemon*.

P. dayii G.W. Clint. III on *Steironema ciliatum* (L.) Raf., near Park gate (DAOM 186154). The conspicuous blackish telia erupt on the underside of the leaves and because teliospores are capable of immediate germination when formed, the telia appear cinereus with the presence of basidia and basidiospores. Illustrations are given in Fungi Canadenses No. 204. This rust is correlated to the long-cycled rusts *P. distichlidis* Ell. & Ev. (F. Can. No. 205) and *Uromyces acuminatus* Arth. (F. Can. No. 203) both with aecial states on *Steironema ciliatum* and uredinial/telial states on *Spartina* spp. in the Poaceae. Only *P. distichlidis* is known in Alberta.

P. granulispora Ell. & Gall. (0,I) II,III on *Allium cernuum* Roth., Buffalo Paddock; Red Rock Canyon, Stony Creek (DAOM 186159); Rowe Lakes Trail. The specimens listed were collected in August when uredinia and telia are fully mature. Aecia occur in small groups on leaves and stems during June and early July. Distribution in Alberta ranges northward through Pincher Creek, Kananaskis and Jasper to the Peace River area and continues westward through British Columbia to the Pacific coast.

P. grindeliae Peck (0)III amphigenous on *Chrysopsis villosa* (Pursh) Nutt., Blakiston Falls; near Park gate; *Grindelia squarrosa* (Pursh) Dunal, Buffalo Paddock (DAOM 186161a); near Lonesome Lake; Bertha Falls Trail. Telia are in small groups, at first bullate or blister-like but soon open fully. Their early bullate appearance resembles aecia and both hosts, plus others in Asteraceae, take the aecial state of the heteroecious *Puccinia stipae* Arth. which alternates in the II,III states to Poaceae - especially *Stipa*. Rusted *Stipa* has not been collected in the Park but is known from Fort Saskatchewan (DAOM 105581) and Craigmyle (DAOM 4170). The specimen from the Buffalo Paddock also bore the mildew *Erysiphe cichoracearum*.

P. heucherae (Schw.) Diet. *sensu lato* III, on *Heuchera cylindrica* Dougl., Blakiston Creek (DAOM 186164); *Mitella nuda* L., trail to Upper Rowe Lake (DAOM 186165); *Tiarella unifoliata* Hook., above Cameron Lake (DAOM

144873). Seven varieties of this species are recognized by Savile (1973) based on characters of non-germinating teliospores and geographic distribution. When microcyclic rusts of Saxifragaceae bear only leptosporic (germinating) telia, there are few usable morphological characters on which to base an identification, then geographic location may be useful in deciding.

P. hieracii (Röhl.) Mart. 0,II[1],II[2],III on *Hieracium umbellatum* L., Sofa Mtn., alt. 1560 m; Belly River at Chief Mtn. Highway; Buffalo Paddock, Blakiston Creek (DAOM 186172); Pass Creek; *Taraxacum officinale* Weber, Bauerman Creek, infected also with the mildew *Sphaerotheca fuliginea*. This cosmopolitan rust of a number of hosts in the Asteraceae is reviewed by Parmelee and Savile (1981) based on North American material.

P. holboellii (Hornem.) Rostr. (= *P. thlaspeos* Schub., *p.p.*) 0,III on *Arabis drummondii* A. Gray, Blakiston Creek (DAOM 186057b), also the mildew *Sphaerotheca fuliginea*; *A. nuttallii* Robinson, Waterton Lakes (DAOM 97464); *Draba cana* Rydb. Waterton Lakes (DAOM 97462). The Canadian distribution of this microcyclic rust and other Canadian hosts is reviewed by Savile in Fungi Canadenses No. 47 where morphological differences from the European *P. thlaspeos* are summarized. Moss (1959) indicates that *Arabis lyalii* S. Wats. is often found intermixed with *A. drummondii*. Rust on the former is known from Banff (DAOM 124971).

P. inclusa Syd. var. inclusa 0,II[1],II[2], III on *Cirsium flodmanii* (Rydb.) Arth., south of Belly River Campground; *C. vulgare* (Savi) Tenore, Rowe Creek (DAOM 186174). This taxon was recognized by Savile (1970) from amongst those relegated to synonomy under *P. cirsii* by Arthur (1934). Infection type (localized *vs.* systemic) and spore characters are utilized in species delimitations of the *Cirsium* rusts.

P. menthae Pers. [0,I] II,III on *Monarda fistulosa* L. var. *menthaefolia* (Graham) Fern., Buffalo Paddock; Blakiston Falls Trail, Dardanelles (DAOM 186181); Blakiston Creek. Elsewhere in Alberta, the rust is known on *Mentha arvensis* L. and in Canada on yet other members of Lamiaceae (Parmelee 1960, 1982).

P. mertensiae Peck III on *Hackelia floribunda* (Lehm.) Johnst., west of Lost Lake, alt. 2100 m (DAOM 186184). This is a new host record for Canada; the only other specimens (DAOM) are on *Mertensia maritima* (L.) S.F. Gray from Chesterfield Inlet, Keew. Dist., NWT.

P. mesomejalis Berk. & Curt. III on *Clintonia uniflora* (Schult.) Kunth, above Cameron Lake (DAOM 186165). There are only four specimens in DAOM from Alberta, three from the above site dated 1935, 1940, 1969 and another from Crowsnest collected in 1926. The rust is widespread in British Columbia on the same host; in eastern Canada the host is *C. borealis* (Ait.) Raf.

P. millefolii Fckl. III on *Artemisia frigida* Willd., Buffalo Paddock (DAOM 186186). This species is represented in DAOM by one other specimen from Alberta: DAOM 97251 on *Achillea sibirica* Ledeb., Bulwark, east of Red Deer.

P. montanensis Ell. (II) III on *Agropyron trachycaulon* (Link) Malté, rolling prairie above Blakiston Creek (DAOM 186187). On the same host, rust occurs also at Lacombe and Banff (DAOM). From adjacent SE British Columbia it is known on *Agropyron spicatum* (Pursh) Scribn. & Smith, *Elymus cinereus* Scribn. & Merr. and both are reported by Moss (1959) from southern Alberta. Cummins (1971) reports the pycnial and aecial states as localized infections on *Berberis fendleri* A. Gray and comparable aecia have been collected in SE

British Columbia on *Mahonia aquifolium* (Pursh) Nutt. (DAOM 126709). *Berberis repens* Lindl. (*Mahonia repens* (Lindl.) G. Don) is reported from extreme SW Alberta. There appears to be opportunity for the full cycle of this rust to be completed in SW Alberta.

P. ornata Arth. & Holw. III on *Rumex occidentalis* S. Wats., wet ground near Park gate (DAOM 185972). The rust is known also from the Craigmyle region (DAOM 4154). *Rumex* spp. and other genera of Polygonaceae are the aecial hosts for *Puccinia phragmitis* (Schum.) Körn. which forms uredinia and telia on *Phragmites*. Reed grass, although present in Alberta is not common and the heteroecious rust is not known and may never occur in the province.

P. palmeri Diet. & Holw. 0,I,III on *Penstemon confertus* Dougl., west of Pincher Creek (DAOM 97486). The rust has not been found in the Park but the proximity of the above collection suggests its likely presence. Position of the teliospore germ pores at the apex of the upper cell and at the septum of the lower cell permits recognition of this rust from *P. dasantherae*, restricted to subgenus *Dasanthera* (Savile 1968), in which teliospore germ pores are depressed.

P. parkeri Dearn. & House III on *Ribes* sp., Red Rock Canyon (DAOM 185973a). Leaves of this specimen also bear the yellow, bullate uredinia of *Cronartium ribicola* which are much smaller than the black, naked telia of the microform *Puccinia*.

P. pazschkei Diet. var. **heterisiae** (Jacks.) Savile on *Saxifraga mertensiana* Bong., Upper Rowe Lake Trail, alt. 2070 m (DAOM 185974). The varietal segregations of this rust are based on teliospore size, position of germ pores and wall sculpturing. This variety occurs also in the Cathedral Lakes region of southern British Columbia and in Glacier National Park, Montana.

P. penstemonis Peck III on *Penstemon albertinus* Greene, Crandell Mtn., alt. 1500 m. Teliospores are pedicillate, clavate and very similar to teliospores of the correlated *Puccinia andropogonis* Schw. on the grass *Andropogon* and with aecia on *Penstemon*. *P. andropogonis* is known from Saskatchewan eastwards. Other hosts of *P. penstemonis* known in adjacent areas of western North America include: *P. deustus* Dougl., *P. serrulatus* Menz. and *P triphyllus* Dougl. ex Lindl. but none are recorded by Moss (1959) or Kuijt (1982) for the Park.

P. poae-nemoralis Otth var. **poae-nemoralis** (= *P. brachypodii* Otth var. *poae-nemoralis* Cumm. & Greene) II,III on *Poa annua* L., Lost Horse Canyon (DAOM 185976). Uredinia contain pale yellow, geniculate, capitate paraphyses. The rust occurs on many species of *Poa* (DAOM) and other grass genera. In Alberta it is on *Poa interior* Rydb. (Camrose), *P. palustris* (Edmonton) and *P. pratensis* L. (Craigmyle). This rust is widespread in Canada occurring well into the arctic region. Cummins (1971) reports the aecial state on *Berberis* but indicates that uredinia and telia survive without it.

***P. poarum** Niels. (= *P. liatridis* (Arth. & Fromme)Bethel in Arth.) 0,I on *Liatris punctata* Hook., Buffalo Paddock (DAOM 185977); [II,III on *Koeleria cristata* (L.) Pers. and other grasses but are yet to be found in Canada]. Conners (1967) lists rusted *Liatris* spp. (as *P. liatridis*) from other provinces but this plus one specimen from Pincher Creek (DAOM 70154), are the first reports for Alberta. Aecia (above) are mostly overmature at

date of collection but are obviously amphigenous with aeciospores 20-30x16-27µm, wall hyaline, ca. 2.0um thick, conspicuously verrucose with 2-3 large pore plugs 3.2-4.8µm diam. plus some smaller ones (Type 4, Savile 1973).

P. polygoni-amphibii Pers. [0,I on *Geranium* spp. in southern Ontario and northeastern U.S.A.]; II,III on *Polygonum amphibium* L. var. *stipulacearum* (Coleman) Fern., near Park gate (DAOM 185978). Other known collections from Alberta (DAOM) are from as far north as Lesser Slave Lake.

P. praegracilis Arth. var. praegracilis. 0,I hypophyllous on *Platanthera stricta*) Lindley (= *Habenaria saccata* Greene), Cameron Lake, overmature when collected in August (DAOM 185979, 124949); II,III on *Agrostis thurberiana* Hitchc., Cameron Lake, alt. 1650 m DAOM 124944) associated with aecia of DAOM 124949. Teliospores possess a few digitate stubs at the apex.

P. recedens Syd. III on *Senecio indecorus* Greene, Red Rock Canyon; Dardanelles (DAOM 185981); Crandell Lake Trail. Telia occur on plants in the Asteraceae including aecial hosts for the correlated, heteroecious rust *Puccinia angustata* Peck which forms uredinia and telia on *Eriophorum* and *Scirpus* (Arthur, 1934) mainly in eastern Canada but occasionally in the Prairies.

P. recondita Rob. ex Desm. 0,I on *Thalictrum dasycarpum* Fisch. & Aré Lall., Sofa Creek (DAOM 185987); *T. venulosum* Trel., Lakeview Ridge (DAOM 185986); [*Anemone multifida* Poir var. *hudsoniana* DC., Pincher Creek]; II,III on *Agropyron trachycaulum* (Link) Malté, Rowe Lakes Trail (DAOM 185992); *Festuca scabrella* Torr., Maskinonge Lake (DAOM 185990); Blakiston Creek.

P. rubefaciens Johans. III on *Galium boreale* L., Stoney Creek (DAOM 185993). This rust is widely distributed in Alberta and is known (DAOM) north to Dawson, Yukon and east to Kenora, Ontario. The dark brown telia on the underside of the leaves are large, regularly to 5.0 mm diam., and conspicuous. Other species of *Galium* are attacked by the long-cycled *Puccinia punctata* Link whose telia are less conspicuous than those of *P rubefaciens*. *P. punctata* is found commonly from western Ont. east to Newfoundland and also in British Columbia but not elsewhere in the west.

P. symphoricarpi Hark. III on *Symphoricarpos albus* (L.) Blake, Blakiston Falls Trail (DAOM 185994) (Fig. 5); [above McDonald Lake, Glacier National Park, Montana]. Teliospores are similar to those of the correlated long-cycled *Puccinia crandallii* on Poaceae and with aecia on *Symphoricarpos*.

P. troximontis Peck (= *P. hieracii* in part sensu Arthur, 1934) 0,II^{1},II^{2},III on *Agoseris glauca* (Pursh) Raf., south of Belly River Campground. The urediniospore characters (broadly ellipsoid with 2 equatorial germ pores and completely echinulate wall) differ from those of *P. hieracii* (ellipsoid to obovoid but clearly flattened with 2 superequatorial germ pores on the flattened faces and the wall below the pores free of spines). *P. hieracii* does not occur on *Agoseris*. Parmelee & Savile (1981) indicate the Canadian distribution of *P. troximontis* to be throughout the prairies and British Columbia. *P. hieracii* occurs in all provinces. A second rust of *Agoseris glauca* is the microcyclic *Puccinia columbiense* Ell. & Ev. It is known from Kananaskis and Banff but not from Waterton Park; its pulvinate, black telia coalesce to form conspicuous, large telia up to 8 mm diam. in contrast to the smaller powdery telia of *P. troximontis*. Elsewhere in North America *P. columbiense* is known on other species of *Agoseris* and on *Hieracium*, *Krigia* and *Prenanthes*.

Pucciniastrum epilobii Otth 0,I on *Abies lasiocarpa* (Hook.) Nutt., Waterton Park, no site given, alt. 1650 m (DAOM 97272); II,III on *Epilobium angustifolium* L., Blakiston Falls Trail (DAOM 185996); near Cameron Lake. This rust is restricted to *Epilobium* spp. of the section Chamaenerion (cf. *P. pustulatum*).

P. goeppertianum (Kühn) Kleb. [0,I on *Abies lasiocarpa* (Hook.) Nutt., Blairmore and Robb, Alberta but not known in the Park]; III on *Vaccinium membranaceum* Dougl., Waterton Park, no site given, (DAOM 105584). Telia surround the enlarged stems occurring in Witches' brooms a symptom unique in *Pucciniastrum*. Elsewhere in Alberta the rust is known (DAOM) on *V. scoparium* Leib., Banff, *V. vitis-idaea* L., Jasper and *Vaccinium* sp. near Crowsnest Mtn.

P. pustulatum Diet. ex Arth. 0,I on needles of *Abies lasiocarpa* (Hook.) Nutt., Akamina Pass, Alt. 1740 m (DAOM 97273); Waterton Park, no site given, in spruce-fir woods, Alt. 1650 m; II [III] on *Epilobium glabberimum* Barbey var. *fastigiatum* (Nutt.) Trel., Bertha Trail, alt. 1500 m; *E. glandulosum* Lehm., near Park gate (DAOM 185999). This is a widely distributed rust in Canada on many species of *Epilobium* section Lysimachion especially on *E. glandulosum* but it occurs also on *Clarkia* and *Fuchsia* spp. The above is the first record in DAOM of the rust on *E. glabberimum*. Aecia occur also on *Abies balsamea* L.

P. pyrolae Diet. ex Arth. 0,I not known; II,III on *Pyrola secunda* L., Rowe Lakes Trail (DAOM 186000). The bullate, localized uredinia are readily distinguished from the systemic uredinia of *Chrysomyxa pirolata*. Other known hosts in Alberta (DAOM) include *P. asarifolia* Michx., *P. chlorantha* Sw., *P. elliptica* Nutt. and *P. minor* L.

P. vaccinii (Wint.) Jørstad [0,I on needles of *Tsuga heterophylla* (Raf.) Sarg., from coastal British Columbia but not collected in the Park. In eastern Canada, aecia occur on *T. canadensis* (L.)Carr.]. II,III hypophyllous on *Vaccinium membranaceum* Dougl., above Cameron Lake (DAOM 105587); [Goat Haunt, Glacier National Park, Montana]; *V. myrtillus* L., Akamina Parkway (DAOM 186004).

[Tranzschelia suffusca (Holw.) Arth. III on *Anemone patens* L. var. *wolfgangiana* (Bess.) Koch., not collected in the Park but the host is common in the province in dry open woods and prairie grasslands (Moss 1959) and occurs in the Park (Kuijt 1982). Rust is currently known on prairie sites from Okatoks to Grande Prairie (DAOM) and the hypophyllous dark powdery telia probably will be found within the Park].

Uredinopsis longimucronata Faull 0,I hypophyllous on current year needles of *Abies lasiocarpa* (Hook.) Nutt., above Cameron Lake (DAOM 97282); II,III hypophyllous on chlorotic and necrotic areas of fronds of *Athyrium felix-femina* (L.) Roth, above Cameron Lake (DAOM 97278, 97279). Both hosts become rusted at least as far north as Whitecourt (54°N) in Alberta (DAOM). *U. phegopteridis* 0,I on *Abies balsamea* (L.) Mill., and II,III on *Gymnocarpium dryopteris* (L.) Newm. (= *Dryopteris disjuncta* (Ledeb.) C.V. Morton) occurs in central Alberta (Lesser Slave Lake) but is not known from the Park. *U. struthiopteridis* Stoerm. *ex* Diet. 0,I on *Abies lasiocarpa* is known from Glacier National Park, Montana; it alternates to *Matteuccia struthiopteris* (L.) Todaro and may well be found in Waterton.

*Uromyces amoenus H.&P. Syd. III on *Anaphalis margaritacea* (L.) Benth. & Hook., Red Rock Canyon (DAOM 186006); Blakiston Falls Trail. Telia erupt from the under surface of the leaves and their presence is indicated by a large chlorotic spot on the upper surface. The rust is known from Atlantic and Pacific Provinces in Canada but is poorly represented in DAOM; this is the first record from Alberta.

U. coloradensis Ell. & Everh. 0,I,III on *Vicia americana* Muhl., south of Belly River Campground on Hwy. 6 (DAOM 186007, 186008). The aecia are systemic and the telia are localized. *V. americana* is the host most abundantly represented in DAOM with specimens from Alberta to Ontario. *V. sparsifolia* Nutt. (sensu Moss) also becomes rusted in Alberta and Saskatchewan (DAOM 105595, Manyberries).

U. hedysari-obscuri (DC.) Car. & Picc. $0,I^1,I^2,III$ on foliage of *Hedysarum alpinum* L., Blakiston Creek; Rowe Lakes Trail; Trail to Upper Rowe Lake (DAOM 186014); Crandell Lake Trail; Red Rock Canyon Trail; 10 km south of Belly River Campground at Hwy 6; *H. boreale* Nutt., Belly River at Hwy 6 (DAOM 186017); *H. sulphurescens* Rydb., Crandell Lake Trail. This rust occurs widely in Alberta and in Canada. Elsewhere in the province it is known on *H. mackenzii* Rich. (DAOM). It is one of the few rusts that has primary aecia (associated with pycnia) and secondary aecia (resulting from reinfection by primary aeciospores). Secondary aecia are often associated with telia.

U. punctatus Schroet. [0,I systemic on *Euphorbia* but not recorded in North America]. II,III on *Oxytropis splendens* Dougl., open prairie near Dardanelles (DAOM 186019); Crandell Lake Trail; Yarrow Creek contiguous to the northern boundary of the Park. In the warm arid regions of British Columbia, *Astragalus* spp. also bear this rust. See Fungi Canadenses No. 24.

U. viciae-fabae (Pers.) Schroet. (0,I,II)III on *Vicia americana* Muhl., 1 km N Cameron Lake. Other records in Alberta extend from the Park northward through Stettler to the Peace River. Other hosts are *Lathyrus venosus* Muhl. var. *intonsus* Butters & St. John, from Edmonton (no specimens from the Park) and *Pisum sativum* L. known elsewhere in Canada but not in Alberta.

USTILAGINALES

Anthracoidea atratae (Savile) Kukk. on *Carex podocarpa* Br., trail to Upper Rowe Lake, alt. 2040 m (DAOM 186026) fig. 6; on *C. aquatalis* Wahl., slough near Park gate (DAOM 186025). The inflorescences are infected and the achenes are replaced by a black globoid mass of spores. Specimens in DAOM are mainly from Arctic Canada and Alaska on the above hosts and on *Carex montanensis* Bailey, *C. miliaris* Michx. var. *major* Bailey and *C. macrochaeta* C.A. Meyer. The TYPE of *Anthracoidea atratae* was described on *C. aquatilis* from Grinnell Lake, Glacier National Park, Montana.

*Ustilago violacea (Pers.) Roussel var. major G.P. Clint. on *Silene parryi* (S. Wats.) Hitchc. & Maguire (= *S. macounii* S. Wats.), trail to Vimy Ridge (DAOM 186022). *U. violacea s.l.* is a common anther smut of Caryophyllaceae. It is widely distributed in Canada and is especially well represented in DAOM from arctic-alpine regions. Spores of this variety are slightly larger than in other varietal taxa. *Silene parryi* is a new host record for Canada (Conners 1967, DAOM) but, as *S. macounii*, it was recorded as a host from Washington State (Fischer 1953).

EXOBASIDIALES

Exobasidium aequale Sacc. (= *E. vaccinii-uliginosi* Boud.) on *Vaccinium myrtillus* L., trail to Upper Rowe Lakes, alt. 2010 m (DAOM 185969). Current season shoots are completely infected, with leaves white below from the fruiting fungus and bright red on the upper surface. The taxonomy for these three species follows Nannfeldt's (1981) study of *Exobasidium* based on European material. His key to the species uses host identification and symptom expression.

E. arescens Nannf. (= *E. vaccinii* auct. *s.l.*) on *Vaccinium myrtillus* L., Rowe Lakes Trail (DAOM 185971); 1 km north of Cameron Lake (DAOM 185970). The fungus causes small, pale coloured leaf spots and fruits on the undersurface.

E. cordilleranum Savile on *Vaccinium membranaceum* Dougl. 1 km north of Cameron Lake (DAOM 185968). Localized infections result in pale brown leaf spots spreading to include much of a leaf surface.

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REFERENCES

Arthur, J.C. 1934. Manual of the rusts of United States and Canada. Purdue Research Foundation, Lafayette, Indiana.

Conners, I.L. 1959. Species of *Leptothyrium* and *Kabatia* on *Lonicera*. Can. J. Bot. 37: 419-429.

Conners, I.L. 1967. An annotated index of plant diseases in Canada. Canada Department of Agriculture, Publication No. 1251. Ottawa.

Cummins, G.B. 1971. The rust fungi of cereals, grasses and bamboos. Springer-Verlag. New York.

Darker, G.D. 1932. The Hypodermataceae of conifers. Arnold Arboretum Harvard University, Jamaica Plain, Mass.

Darker, G.D. 1967. A revision of the genera of Hypodermataceae. Can. J. Bot. 45: 1399-1444.

Fischer, G.W. 1953. Manual of the North American smut fungi. Ronald Press Co., New York.

Forest Insect and Disease Survey for 1970. 1971. Canadian Forestry Service, Can. Dept. Fisheries and Forestry, Ottawa.

Forest Insect and Disease Survey for 1971. 1972. Canadian Forestry Service, Environment Canada, Ottawa.

Fungi Canadenses. National Mycological Herbarium, Biosystematics Research Institute, Research Branch, Agriculture Canada, Ottawa, Ontario.

Hiratsuka N. and S. Kaneko, 1982. A taxonomic revision of *Melampsora* on willows in Japan. Rept. Tottori Mycol. Inst. (Japan) 20: 1-32.

Hitchcock, C.L. and A. Cronquist, 1964. Part 2. *in* Vascular flora of the Pacific Northwest by C.L. Hitchcock *et al*. Univ. Wash. Press, Seattle.

Kuijt, J. 1982. A flora of Waterton Lakes National Park. University of Alberta Press, Edmonton, Alberta.

Lawrence, J.J. and Y. Hiratsuka, 1972. Forest fungi collected in Waterton Lakes National Park, Alberta. Forestry Service, Environment Canada. Information Report N0R-X-20. Edmonton.

Moss, E.H. 1959. Flora of Alberta. University of Toronto Press, Toronto Ontario.

Nannfeldt, J.A. 1981. *Exobasidium*, a taxonomic reassessment applied to the European species. Symbol. Bot. Upsal. 23: 1-72.

Parmelee, J.A. 1960. The Fungi of Ontario. I Uredinales. Can. Dept. Agr. Publication 1080.

Parmelee, J.A. 1977. The fungi of Ontario. II Erysiphaceae (mildews). Can. J.Bot. 55: 1940-1983.

Parmelee, J.A. 1982. Records of parasitic fungi in Manitoba based on collections from Riding Mountain National Park, 1979. Canadian Field-Naturalist 96: 143-155.

Parmelee, J.A. and D.B.O. Savile, 1981. Autoeceous species of *Puccinia* on Cichoreae in North America. Can. J. Bot. 59: 1078-1101.

Savile, D.B.O. 1967. Evolution and relationships of North American *Pedicularis* rusts and their hosts. Can. J. Bot. 45: 1093-1103.

Savile, D.B.O. 1968. The rusts of Cheloneae (Scrophulariaceae). Nova Hedwigia 15: 369-392.

Savile, D.B.O. 1970. Autoecious *Puccinia* species attacking Cardueae in North America. Can. J. Bot. 48: 1567-1584.

Savile, D.B.O. 1973. Revisions of the microcyclic *Puccinia* species on Saxifragaceae. Can. J. Bot. 51: 2347-2370.

Savile, D.B.O. 1973. Aeciospore types in *Puccinia* and *Uromyces* attacking Cyperaceae, Juncaceae and Poaceae. Rep. Tottori Mycol. Inst. (Japan) 10: 225-241.

Savile, D.B.O. 1976. *Phragmidium ivesiae* and its allies in North America. Can. J. Bot. 54: 1690-1696.

Shaw, C.G. 1973. Host fungus index for the Pacific Northwest - I. Hosts. Wash. Agr. Exp. Stat. Bull. 765.

Thomson, S.C. and P.M. LeClair, 1975. A mycological survey of St. Lawrence Islands National Park with methodology. Biosystematics Res. Inst., Agriculture Canada. Processed report.

Ziller, W.G. 1974. The tree rusts of western Canada. Canadian Forestry Service, Publication No. 1329, Environment Canada.

HOST INDEX

Bracketed names mean that the fungi are suspected to occur in the Park but proof is lacking.

Carex
    Anthracoidea atratae
    Puccinia atrofusca
    Puccinia caricina
    Puccinia caricis-shepherdiae

Castilleja
    Sphaerotheca fuliginea

Cerastium
    Melampsorella caryophyllacearum

Chimaphila
    Mycosphaerella chimaphilae

Chrysopsis
    Puccinia grindeliae
    [Puccinia stipae]
        see P. grindeliae

Cirsium
    Puccinia cnici
    Puccinia inclusa var. inclusa

Clintonia
    Puccinia mesomejalis

Cornus
    [Glomopsis corni]

Crataegus
    [Gymnosporangium clavipes]
    Podosphaera clandestina

Cystopteris
    [Hyalopsora polypodii]

Draba
    Puccinia holboellii
    Sphaerotheca fuliginea

Elymus
    [Puccinia montanensis]

Epilobium
    Puccinia epilobii
    Puccinia pustulatum

Eriogonum
    Phyllosticta eriogoni

Eriophorum
    [Puccinia angustata]
        see P. recedens

Festuca
    [Puccinia crandellii]
    Puccinia recondita

Gaillardia
    Sphaerotheca fuliginea

Galium
    Leptotrochilla verrucosa
        anamorph: Placosphaeria punctiformis
    Puccinia rubefaciens
    [Puccinia punctata]
        see P. rubefaciens

Geranium
    [Puccinia polygoni-amphibii]
    Sphaerotheca macularis

Geum
    Ramularia gei

Grindelia
    Erysiphe cichoracearum
    Puccinia grindeliae
    [Puccinia stipae]
        see P. grindeliae

Gymnocarpium
    [Uredinopsis phegopteridis]
        see U. longimucronata

Habenaria see Platanthera

Hackelia
    Puccinia mertensiae

Hedysarum
    Uromyces hedysari-obscuri

Heracleum
    Phyllachora heraclei

Heuchera
    Puccinia heucherae
    Sphaerotheca fuliginea

Hieracium
[Puccinia columbiense]
see P. troximontis
Puccinia hieracii

Juniperus
[Gymnosporangium clavariiforme]
[Gymnosporangium clavipes]
Gymnosporangium nelsonii
Gymnosporangium nidus-avis
Gymnosporangium tremelloides
Herpotrichia juniperi
Lophodermium juniperi

Koeleria
[Puccinia poarum]

Krigia
[Puccinia columbiense]
see P. troximontis

Lappula
Erysiphe cichoracearum

Lathyrus
Microsphaera penicillata

Ledum
Chrysomyxa ledi var. glandulosi

Lepidium
Peronospora parasitica

Liatris
Puccinia poarum

Lonicera
Kabatia lonicerae var. involucrata
[Leptothrium periclymeni var. periclymeni]
Ramularia lonicerae

Lycopus
Erysiphe cichoracearum

Mahonia
Cumminsiella mirabillissima
[Puccinia montanensis]

Matteuccia
[Uredinopsis struthiopteridis]
see U. longimucronata

Mentha
Erysiphe cichoracearum
[Puccinia menthae]

Menziesia
Rhytisma arbuti

Mitella
Puccinia austroberingiana ssp. austroberingiana
Puccinia heucherae

Monarda
Erysiphe cichoracearum
Puccinia menthae

Osmorhiza
Septoria osmorhizae

Oxytropis
Microsphaera diffusa
Uromyces punctatus

Pedicularis
Puccinia clintonii

Penstemon
Puccinia dasantherae
[Puccinia palmeri]
see P. dasantherae
Puccinia penstemonis
Ramularia nivosa

Philadelphus
Ramularia philadelphia

Phragmites
[Puccinia phragmitis]
see P. ornata

Picea
Chrysomyxa ledi var. glandulosi
Chryxomyxa pirolata
[Chrysomyxa weirii]
see C. pirolata
Herpotrichia juniperi

Pinus
    Coleosporium asterum
    Cronartium ribicola
    Endocronartium harkenessii
    Herpotrichia juniperi

Platanthera
    Puccinia praegracilis var. praegracilis

Poa
    [Puccinia crandallii]
    Puccinia poae-nemoralis

Polemonium
    Erysiphe cichoracearum

Polygonum
    Erysiphe polygoni
    Puccinia bistortae
    Puccinia polygoni-amphibii var. persicariae

Populus
    Melampsora medusae
    Melampsora occidentalis
    Uncinula adunca

Potentilla
    Phragmidium andersoni
    Phragmidium ivesiae

Prenanthes
    [Puccinia columbiense]
        see P. troximontis

Prunus
    Apiosporina morbosa
    Podosphaera clandestina

Pseudotsuga
    [Melampsora medusae]

Pteridium
    Cryptomycina pteridis

Pyrola
    Chrysomyxa pirolata
    Pucciniastrum pyrolae

Ranunculus
    Erysiphe polygoni
    [Puccinia blyttiana]

Rhamnus
    [Puccinia coronata]

Ribes
    Cronartium ribicola
    [Puccinia caricina]
    Puccinia parkerae

Rosa
    Phragmidium montivagum

Rubus
    Phragmidium occidentale

Rumex
    Puccinia ornata
    [Puccinia phragmitis]
        see P. ornata

Salix
    Melampsora epitea
    Melampsora paradoxa
    Rhytisma salicinum
    Uncinula adunca

Saxifraga
    Puccinia angustata
    Puccinia pazschkei var. heterisiae

Scirpus
    [Puccinia angustata]
        see P. recedens

Senecio
    Puccinia recedens
    [P. angustata]
        see P. recedens
    Ramularia senecionis

Shepherdia
    Puccinia caricis-shepherdiae
    Puccinia coronata

Silene
    Ustilago violacea

Smelowskia
    Puccinia aberrans

Solidago
    Coleosporium asterum

Sorbus
    Gymnosporangium tremelloides

Spartina
    [Puccinia distichlidis]
        see P. dayii
    [Uromyces acuminatus]
        see P. dayii

Steironema
    Puccinia dayii

Stellaria
    [Melampsorella caryophyllacearum]

Stipa
    [Puccinia stipa]
        see P. grindeliae

Symphoricarpos
    Microsphaera diffusa
    Puccinia crandallii
    Puccinia symphoricarpos

Taraxacum
    Puccinia hieracii
    Sphaerotheca fuliginea

Thalictrum
    Erysiphe polygoni
    Puccinia recondita

Tiarella
    Puccinia heucherae var. heucherae

Tsuga
    [Pucciniastrum vaccinii]

Urtica
    [Puccinia caricina]

Vaccinium
    Exobasidium aequale
    Exobasidium arescens
    Exobasidium cordilleranum
    Podosphaera myrtilliana
    Pucciniastrum vaccinii

Vicia
    Uromyces coloradensis
    Uromyces viciae-fabae